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On the Principle of Compositionality

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INTRODUCTION

The Principle of Compositionality (briefly, Compositionality) means that the meaning of a complex expression is a function of the meanings of its constituent parts. Philosophers and linguists who support the “naïve theory” or extensionality in semantics think that Compositionality holds. Moreover, Compositionality seems to be supported by the Learnability of languages.

However, it has been said that Compositionality fails in some contexts: Frege’s Hesperus-Phosphorus puzzle is a famous example of this failure. Compositionality is also said to fail in attitudes sentences, which describe so called “propositional attitudes”.

But simply arguing that Compositionality holds or does not hold does not explain the important points about Compositionality. What do we mean by Compositionality? And what do we mean by the success or failure of Compositionality? These issues are discussed in this paper, mainly by presenting Hintikka’s careful and critical examination of Compositionality. Although most of my own argument is indebted to Hintikka’s, my conclusion is not the same as his. It seems to me that Compositionality in which component meanings are considered in the context of the whole expression holds in natural languages.

COMPOSITIONALITY BASED ON LEARNABILITY

One of the most important and strongest supporting arguments for Compositionality is probably the argument from the Learnability of natural languages. I will begin by presenting the argument from Learnability that was first suggested by Davidson, and later reconstructed by Hintikka.¹

We must learn to use natural languages. According to Davidson, a necessary feature of a learnable language is that we can give a constructive account of the meaning of the sentences in the language. Correspondingly a theory of meaning of natural languages must be able to give a constructive account of the meaning of the sentences in the language.²

In our language learning, there are some conditions. One is that we must be able to define a predicate of expressions, based solely on their formal properties, that picks out the class of meaningful expressions (sentences). Another is that we must be able to specify, in a way that depends effectively and solely on formal considerations, what every sentence means.³

And, if we regard the meaning of each sentence as a function of a finite number of features of the sentence, we can understand what there is to be learned, and also how an infinite aptitude can be encompassed by finite accomplishments. So if we call an expression a semantical primitive, provided the rules which give the meaning for the sentences in which it does not appear do not suffice to determine the meaning of the sentences in which it does appear, then a learnable language has a finite number of semantical primitives.⁴

Davidson's main purpose in this part of the paper is to arrive to the conclusion that a learnable language has a finite number of semantical primitives. Another conclusion is that Tarski's truth theory is one of the most successful accounts of

¹ There is also support from extensionality, but Hintikka thinks that Compositionality and extensionality have no relation (Theories of Truth and Learnable Languages, 49-50).

² Theories of Meaning and Learnable Languages, 3.

³ *ibid.*, 7-8.

⁴ *ibid.*, 8-9.

meaning that is compatible with several conditions of language learning. These considerations of Davidson's seem natural, but they are not formal arguments.

Now let's return to Compositionality. There are important steps from the Learnability of languages to a recursive type of truth-conditional semantics. In these steps, Compositionality seems to be "the mediating link" between Learnability and a recursive truth theory. Let's closely follow the steps from Learnability to Compositionality, as they are reconstructed by Hintikka.⁵ The sequence is the following:

0. Languages must be learnable.
1. The meaning of a given complex expression, say E , can be gathered from a finite number of clues in E .
2. These clues have to be syntactical, based either on the vocabulary of E or else on the structure of E .
3. In this sense, the meaning of E is a function of the contributions of its several constituent components or parts.
4. But such a contribution of a constituent part e to the meaning of the larger whole can safely be identified with its "meaning", the meaning of e .
5. Hence the meaning of the whole is determined by the meanings of its components (Compositionality holds).

The crucial step is from 3 to 4, where contributions of components and meanings of components are identified. To secure this step, we may need a principle; for example, a word or other simple grammatical constituent has meaning only in a context. Moreover, there are several points to be considered concerning this. What do we think about the meaning of a component of a complex expression? What do we think about the contribution of a component to the meaning of a complex expression? To answer

⁵ Theories of Truth and Learnable Languages, 38.

these questions, let's return to our starting point, the definitions of Compositionality.

DEFINITIONS OF COMPOSITIONALITY

Simply put, Compositionality means that the meaning of a complex expression is a function of the meanings of its constituent parts. But what is meant by "function" or "the meanings of its constituent parts"?

First, let's consider "the meanings of its constituent parts". According to Hintikka, there seem to be two definitions of Compositionality:⁶

Definition 1: The meanings of the component parts e_1, e_2, \dots, e_i of a complex expression E , considered *in isolation*, determine the meaning of E .

Definition 2: The meanings of the component parts e_1, e_2, \dots, e_i of a complex expression E , considered *in E* , determine the meaning of E .

These two definitions of Compositionality are the same for the most part, but differ on a crucial point. The difference is between "considered in isolation" and "considered in E (a complex expression)". In definition 1, the meanings of the component parts of the complex expression are considered in isolation, so there it must be presupposed that the meaning of an expression is the same in any context, and that meaning in isolation is always possible.... This definition reflects a naive understanding of Compositionality.

In definition 2, on the other hand, the meanings of the component parts of the complex expression are considered in the whole complex expression. According to Hintikka, the presupposition that the meaning of an expression is the same in any context is also required. Frege's Compositionality is an example of this definition, and in addition to this definition, another principle concerning meanings must be

⁶ *ibid.*, 50.

presupposed. The totality of Frege's Compositionality is as follows.

Main principle: The meaning of a complex expression is a function of the meaning of its constituent parts.

Supplementary principle: A word or other simple grammatical constituent has meaning only in a context.

But Compositionality in definition 2 with this supplementary principle may not be adequate. Definition 2 has a different kind of problem, and probably this definition is not a genuine one. The problem is that the meaning of "contribution" may become obscure, that is, there seems to be two kinds of contribution. One is direct contribution and the other is indirect contribution. I will return to this in the final section.

ARGUMENTS AGAINST COMPOSITIONALITY

In this section, I will present the arguments against Compositionality given by Hintikka. Hintikka's aim is not only to argue for the failure of Compositionality, but also to argue for the failure of recursive truth-conditional semantics and to allude to the priority of game-theoretical semantics. However, since we are now considering the problem of the validity of Compositionality, I will focus only on the first of Hintikka's arguments.

Hintikka's criticism consists of two parts. First, he insists that Learnability alone does not make Compositionality very natural. Additional presuppositions are necessary to conclude Compositionality from Learnability. Second, Hintikka gives several examples in which Compositionality does not hold because of the lack of additional presuppositions (mainly the context-independence thesis and the determinacy thesis). The necessary additional presuppositions are the following.⁷

⁷ Theories of Truth and Learnable Languages, 40-42.

(a) context-independence thesis:

The meaning of an expression must not depend on the context in which it occurs.

(b) inside-out principle:

The proper direction of semantical analysis is from inside out in a sentence or other complex expression.

(c) parallelism thesis:

Syntactical and semantical rules operate in tandem.

(d) invariance thesis:

When E is formed from certain simpler strings e_1, e_2, \dots, e_r these very expressions will become “parts” (constituent expressions) of E .

(e) determinacy thesis:

The meaning of E must be completely determined by the meanings of the expressions E_1, E_2, \dots, E_j from which it is constructed.

Because the relations between the above presuppositions are not so clear in Hintikka’s paper, they must be considered here. *First*, Learnability must be supplemented with the context-independence thesis to conclude that Compositionality holds. *Second*, the context-independence thesis is considered as a variant of the inside-out principle, that is, the inside-out principle presupposes the context-independence thesis. *Third*, the parallelism thesis with the invariance thesis, the determinacy thesis and some other theses (not mentioned here) make the inside-out principle hold. *Fourth*, the Learnability of languages presupposes the parallelism thesis. *Fifth*, the inside-out principle implies Compositionality.

Considering all of these points, we can conclude:

Learnability, (d) the invariance thesis, (e) the determinacy thesis and some other theses conjointly imply (b) the inside-out principle (from points 3 and 4 above).

Hintikka does not explicitly state that the inside-out principle implies Compositionality (point 5 above). According to his main argument,⁸ the inside-out principle seems to supplement Learnability to imply Compositionality. But this relation is not so explicit. In his illustration of the relations of these theses and this principle, there is no place for the inside-out principle, but there is a place for Compositionality. The content of the principle seems to say the same thing as Compositionality, but from a different point of view. If the inside-out principle is the same as Compositionality, or if it implies Compositionality, then:

Learnability, (e) the determinacy thesis and some other theses conjointly imply Compositionality (from point 5 above).

Learnability, (a) the context-independence thesis, (e) the determinacy thesis and some other theses conjointly imply Compositionality (from points 1 and 2).

If these theses and principles are related in this way, and if some of these theses are not actually correct, as Hintikka argues in this paper,⁹ then Compositionality does not hold in natural languages.

CRITICAL COMMENTS

In this part, I will try to say something against Hintikka's view. It seems to me that the context-independence thesis and the invariance thesis are not necessary for Compositionality, and that the spirit of the inside-out principle is not necessary for

⁸ *ibid.*, 40.

⁹ *ibid.*, 43-49.

Compositionality either.

Concerning the context-independence thesis: Is the context-independence thesis necessary for the success of Compositionality? Hintikka's account is that if the meaning of e (a component expression) varies in each context, then the contribution of e cannot be determined. This consideration seems to come from the spirit of the inside-out thesis. Even without the context-independence thesis, we can determine the contribution of e by context. Hintikka's rejection seems to arise from his insistence that determination of a context must be done outside-in. But is that really true? If a context is given only from a grammatical structure, then the inside-out thesis holds without problem.¹⁰

Concerning the invariance thesis: Complex functions also act as simple functions. Each contribution may not be "direct", but it contributes to the meaning of E in some definite way. I will return to this in the final section.

Then what theses and principles are required by Compositionality? I do not think that Compositionality is completely deduced from any thing else, but I think that, at least, the determinacy thesis and the parallelism thesis are required for Learnability.

Concerning the determinacy thesis: Compositionality worthy of the name must satisfy the constraint of the determinacy thesis.¹¹ I also think that this thesis can be extended without dismissing the parallelism thesis. That is: the meaning of E must be completely determined by the meanings of the expressions E_1, E_2, \dots, E_j from which it is constructed and also by the structural features of E .

Concerning the inside-out principle: As I argued above, Hintikka probably thinks that the inside-out principle is the same as Compositionality, or that it implies Compositionality. But the spirit of Compositionality is not the same as the spirit of the inside-out principle in a rigid sense. It seems that Compositionality without the spirit of the inside-out principle is possible, even without dismissing the parallelism thesis. The contributions of the parts of a complex sentence must be definite, but if the contributions are syntactical, the contributions need not immediately come from inside

¹⁰ If a context is also given from the meaning of the whole expression, then the inside-out thesis cannot hold.

¹¹ Crimmins, *Talk About Beliefs*, 9.

the parts. If the outside-in contributions used in determining the meanings of parts of a complex expression are syntactical, we can safely construct the meaning of the expression. In this case, it is appropriate to say that Compositionality is in the spirit of *syntactical-constructivity* rather than the inside-out principle.

COMPOSITIONALITY IN DEFINITION 2

Finally, what can we think about Compositionality, and does it hold in natural languages? I think that definition 2 is good enough as a definition of Compositionality, and that it holds without supplementary theses such as the context-independence thesis, the invariance thesis and the inside-out principle in a rigid sense. Hintikka's two criticisms about definition 2 of Compositionality, and my arguments against them are as follows:

(1) Even if meanings in isolation are prohibited, meanings in context can vary, so "there would not be any such thing as *the* contribution of *e* to the respective meanings of the different complex expressions in which *e* can occur."¹²

But, I think there is no problem in varying the contribution of *e* to each complex expression. The important thing is that we can determine the contribution. Then how can we do this?

In a rigid sense, syntactical-constructivity and the inside-out principle are different things. The inside-out principle states that the proper direction of semantical analysis is from inside out in a sentence or other complex expression. But this is not necessary to construct the meaning syntactically.

(2) "It is not clear, however, that we can always speak of the meanings *within* the *context*," as the meanings in isolation.

For example, if the invariance principle fails, "then the meanings of *E* might be

¹² Theories of Truth and Learnable Languages, 39.

determined by the meanings of certain other expressions e'_1, e'_2, \dots, e'_j obtainable from e_1, e_2, \dots, e_i and E . Then the procedure for determining the meaning of E might turn completely on the meanings of e'_1, e'_2, \dots, e'_j and hence bypass e_1, e_2, \dots, e_i altogether. In such circumstances it might be nonsense to speak of the respective meanings of e_1, e_2, \dots, e_i in the context E .¹³

But, how can we bypass e_1, e_2, \dots, e_i altogether? Even if the invariance principle fails, $e'_1 = e'_1(e_1, e_2, \dots, e_i, E)$, $e'_2 = e'_2(e_1, e_2, \dots, e_i, E)$, So we cannot bypass the original simple expressions altogether. Of course it remains a problem that e'_1, e'_2, \dots, e'_j are also determined by E . This may cause the failure of the inside-out principle.

Even if Hintikka's criticism about definition 2 is not justified, there is a further argument of Davidson against Frege's Compositionality. According to Davidson, Frege's treatment of belief sentences does not satisfy the condition that a learnable language has a finite number of semantical primitives.¹⁴ The main reason is that there is no theory which interprets the new expressions (expressions for senses, introduced after the appearances of verbs like 'believes') as logically structured. But is there really no systematic way of constructing meanings of parts? For example, if we think of the contribution of a part as a compound of its usual meaning and its structure, then we can systematically introduce a new expression of this contribution. And Davidson's own resolution in "On Saying That" does not seem to present any logical interpretation of 'that' in relation to succeeding expressions.

¹³ *ibid.*, 51.

¹⁴ Theories of Meaning and Learnable Languages, 14.

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Philosophers and linguists who support the naïve theory or extensionality in semantics think that Compositionality holds. Moreover, Compositionality seems to be supported by the Learnability of languages. But many philosophers have argued that Compositionality fails in some contexts by many philosophers.

Now simply arguing that Compositionality holds or does not does not explain the important point about Compositionality. What do we mean by Compositionality? And what do we mean by the success or failure of Compositionality? These issues are discussed in this paper by presenting Hintikka's careful and critical examination of Compositionality. The author thinks that Compositionality in which component meanings are considered in the context of the whole expression holds in natural languages.